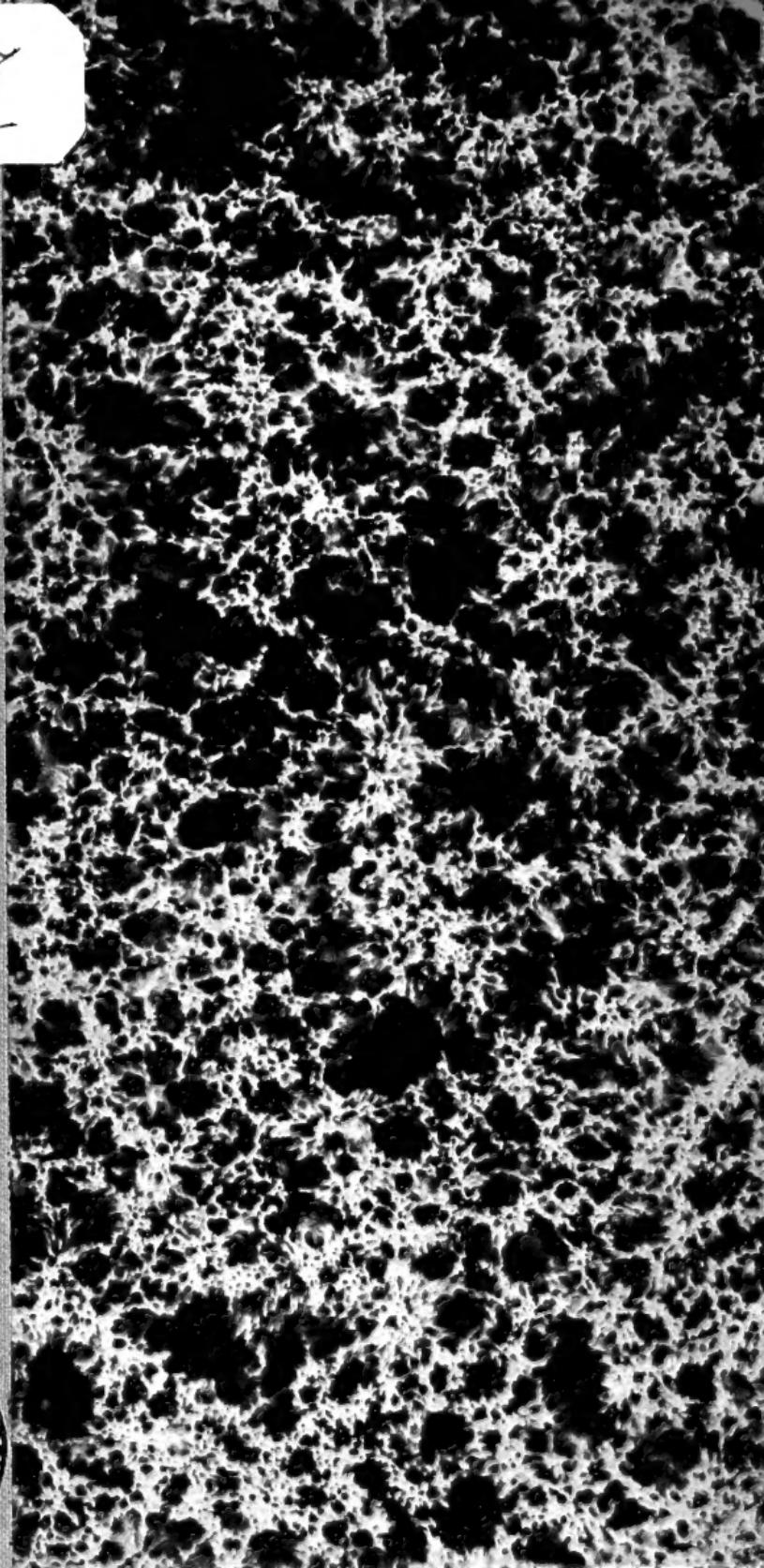


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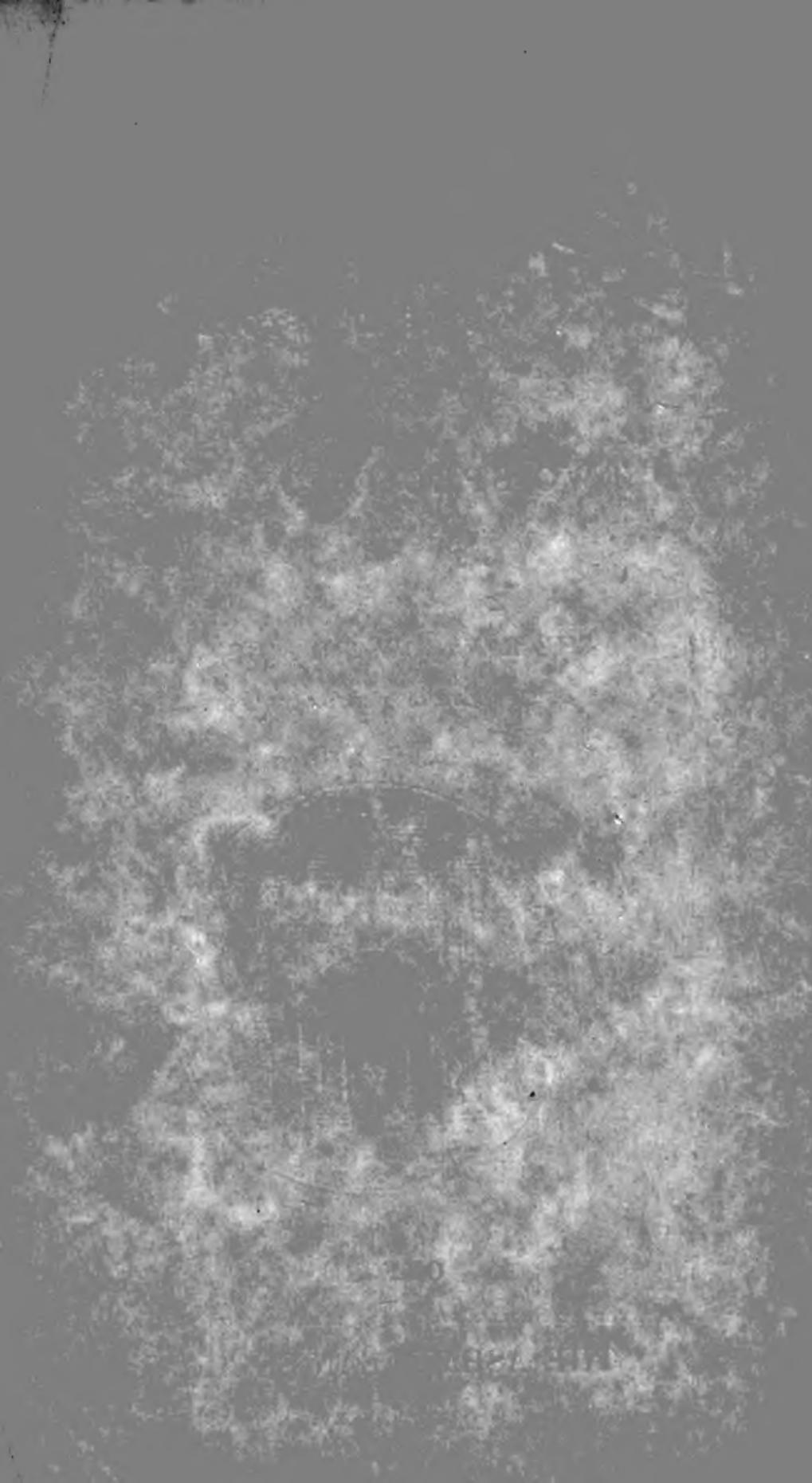
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OBSERVATIONS
ON THE
NATURAL HISTORY
OF
TWO SPECIES OF WASPS.

BY
THE REV. EDWARD BIGGE, M.A.
FELLOW OF MERTON COLLEGE.



OXFORD,

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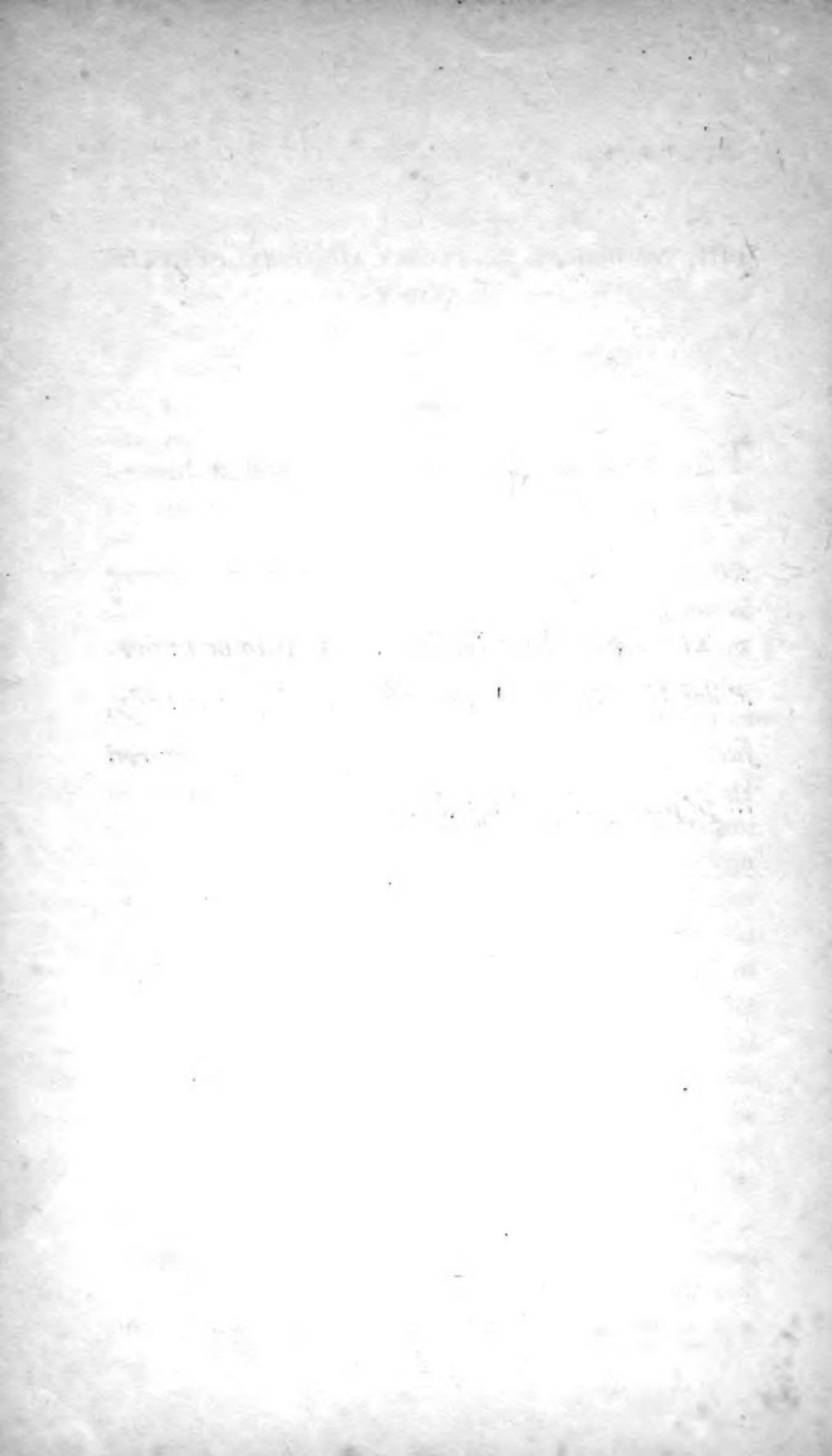
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ON
THE NATURAL HISTORY OF TWO SPECIES
OF WASPS.

READ TO THE ASHMOLEAN SOCIETY, FEB. 27, 1835.

THE following remarks upon the natural history of two species of wasps, both of which are common in Great Britain, are offered to the notice of the Ashmolean Society, in the hope that they may tend to reconcile the contradictions observable in the works of all the authors who have written on the subject, from the times of Swammerdam and Ray, to the present period. Very few original observations appear to have been made since Reaumur and De Geer turned their attention to the habits of these insects; and the accounts of later writers seem nearly all taken, and frequently without acknowledgment, from the works of those illustrious naturalists. It may indeed seem presumptuous in me to differ from such men; but it is perhaps better to state the points of disagreement at once, in order that the results of my own observations, made during the summers of 1833 and 1834, may furnish additional data for any members of the Society who may feel inclined to follow up the subject, and thus either verify or refute them.

The two species which are the subject of this paper, are the *Vespa Vulgaris*, or ground wasp, and the *Vespa Britannica*, or tree wasp. The former is common in all parts of the island; the

latter, though occasionally met with in the southern counties of England, seems principally to abound in the northern districts, and in Scotland. It is by no means peculiar to Britain, as the name would seem to imply, but is spread over all the northern parts of Europe in great abundance. Some confusion has arisen with regard to the *Vespa Vulgaris*, whose habits are so ably described by Reaumur, in the sixth volume of his History of Insects. The species named *Vespa Vulgaris* by Linnæus, is in fact the *Vespa Britannica*, and is described by him, and by De Geer, as fixing its nest to beams in sheds, or under the eaves of houses, or to low trees; but the French entomologists afterwards bestowed the specific name *Vulgaris* upon that wasp which was most abundant in their own country, and in the southern parts of Europe, and whose nest is always formed in the ground. The error seems to have hitherto passed unnoticed, except that Shaw remarks that some confusion seems to prevail on the subject. The species now called *Vespa Vulgaris*, seems to be the *Vespa Gallica* of Linnæus; but as he does not mention the situation of the nest, it is not quite certain. He merely says, "Habitat in Europa Australiori^a." Fabricius describes it as "Vespa Gallica, affinis Vulgari, at minor^b." Mr. Wood, in his "Linnæan Genera of Insects," has figured the *Vespa Britannica* under the name of *Vespa Vulgaris* of Linnæus, and so far he is correct. But he describes the species as living in the ground, which is not the case with the *Vespa Vulgaris* of Linnaeus. Leach seems to have been the first who

^a Linn. Syst. Nat. vol. ii. p. 949.

^b Fabricius, Genera Insectorum, vol. i. p. 460, ed. 1781.

gave the specific name *Vespa Britannica* to the tree wasp; but its habits and economy had already been fully described by De Geer^c.

The points of difference between the two species are as follow:

1. The tree wasp (*Vespa Britannica*) has a reddish brown spot near the point of insertion of the wings. It is seldom visible in dried specimens.

2. In the males and neuters, the base of the antennæ is yellow on the outer side, instead of being entirely black, as in the ground wasp; but the females often present exceptions to this distinction.

3. The tree wasp has two yellow spots on the back part of the corselet, whilst the ground wasp has from four to six.

4. The spots on the abdomen of the tree wasp are not so much detached from the black bands as in the other species, and, I think, less so in the males than the females. The markings on the abdomen, however, vary so much in different individuals that they cannot be safely relied on as a criterion of species. Linnaeus drew a distinction between the hornets (*Vespa Crabro*) and the true wasps, founded on these marks, but it certainly cannot be considered as decisive; and the varieties enumerated by different authors, and particularly by Geoffroy, shew that the attention paid to this point has tended to create confusion rather than lessen the difficulty. Wasps taken from the same nest often present considerable variations in the marks on the abdomen, and no judgment can be formed from specimens in cabinets, which undergo great changes in drying.

5. Independently of the markings just mentioned,

^c Vol. ii. p. 766 et seq. pl. 26.

the tree wasp has more black upon the body generally, than the other species.

6. The tree wasp is rather larger.

7. The organs of generation in the males of the two species, as shewn by the plates in Reaumur and De Geer, vary considerably.

8. The abdomen in each species contains the same number of rings, viz. six in the females and neuters, and seven in the males.

As the object of this paper is not to give a detailed account of the economy of wasps, which would occupy a volume, but merely to mention some statements of various authors respecting them, which have not been borne out by my own observations, I shall only give a slight outline of their habits, in order to make the details more intelligible. The interior arrangement of the nests of both species is so nearly alike, that one description will serve for both.

It can be hardly necessary to state that societies of wasps, as of bees, consist of three different classes of inhabitants, viz. males, females, and neuters. The females, which are much larger than the others, are familiarly known to every body as the large breeding wasps which appear in the spring. The neuters, or imperfectly developed females, are the ordinary wasps which infest our houses and gardens, and form the bulk of the colony. The males, not differing much from these in size or general appearance, are yet easily recognised by the practised observer, from the greater length of their antennæ, and their longer and more slender form: besides which, as is the case with the males in all this class of insects, they have no sting.

Early in the spring the female wasps, which alone

survive the winter, and which have been impregnated in the preceding autumn, seek out a suitable situation for their nests, and proceed to form a few cells in which they deposit the eggs of *neuters only*. These eggs are often laid when the cell is in an unfinished state, in order that they may be hatched as early as possible, and proceed to assist the foundress of the nest in her labours. Two or more females never unite in forming a colony, but each nest is the work of a single individual.

The author of the Insect Miscellanies (p. 307) states, that "the female wasp, instead of producing "at her first laying the eggs of workers only, depo- "sits those of *males* and *females*; but the latter, "when hatched and come to maturity, are only the "sixth part of the size of their mother, and only "lay the eggs of males." This statement seems to have been founded on some remarks of M. Perrot, a friend of Huber^d, who supposed that there were two sorts of female wasps, the smaller of which were not larger than neuters, and which only laid the eggs of males; but he did not succeed in establishing this fact, which is entirely opposed to my own observation, as well as that of other persons who have practically attended to the subject. I have never found the eggs of males or females, early in the year, in any nest; and all the female wasps I have ever examined have been nearly as large as the foundress of the colony. Since the end of their creation is the reproduction of the species, and as the females do not lay eggs the same year that they are hatched, (according to most authors,) or take any part in the labours of the colony, they

^d Vide Kirby and Spence, vol. ii. p. 108.

are *a priori* less likely to be hatched early in the year than the neuters, who are constantly employed in building and enlarging the nest, and in feeding the larvæ during the breeding season, and whose number far exceeds that of both the males and females put together; and it appears from observation, that the actual state of the case agrees with what we should have been led to expect.

The tree wasp frequently attaches its nest to a beam in a shed, or under the eaves of a house; but generally speaking it is found suspended from the branch of a young tree, or in a thorn hedge, and without much apparent pains being taken to conceal it. I have more than once seen a nest hanging over a walk in a young plantation, so that it could not escape the observation of any one passing that way; and one of the specimens now in the Museum was placed so near a gate leading into a wood, that it was hardly possible to go through it without disturbing the inmates. I have more often seen them attached to larch trees than to any other; but they are also found in the Scotch fir, the elm, and the beech, and still more frequently in gooseberry bushes in gardens, where they are likely to find abundance of food^e. Professor Rennie, in the Insect Architecture, (p. 82,) observes, that "the tree which the "Britannic wasp prefers, is the silver fir, whose "broad flat branch serves as a protection both from "the sun and the rain." I have seen some hundreds of nests in young plantations, which abounded with silver firs, but I hardly ever saw a single in-

^e One of the specimens in the Museum has three holes in the top of it, in which large red gooseberries were growing at the time it was taken.

stance of their being suspended from that species of pine. The larch, which they seem to prefer, affords less protection than almost any other tree; but from the nature of the materials of which the nest is composed, they are nearly independent of shelter either from heat or wet.

It was not till Reaumur had devoted many years to the study of insects, that he succeeded in discovering the nature of the materials employed by wasps in forming their habitations. It is unnecessary to repeat his interesting account, as it has been copied into almost every subsequent work on the subject^f. He asserts that the wood which they prefer for that purpose is such as has been long exposed to the weather, and is old and dry. White^g, of Selborne, and Kirby and Spence^h, on the contrary, maintain that they make use of sound timber only. I have often observed wasps in the act of collecting materials from fir wood, but not from any other species, and this was never in a state of advanced decay, but nearly in the condition described by Reaumur. The paper of which the ground wasp forms its nest is more friable than that used by the other species, and some nests are of a much more yellow tint than others, and in fact resemble as nearly as possible the colour of rotten wood. It seems probable therefore that the ground wasp employs wood in various states of decay, but I believe the *Vespa Britannica* only uses wood nearly sound, on account of the greater degree of toughness requisite in a nest that is to resist the action of the weather. In such cases it gnaws the softer parts

^f Reaumur, vol. vi. p. 182. ^g White's Selborne, vol. ii. p. 228.

^h Kirby and Spence, vol. i. p. 508.

away, leaving the streaks or fibres standing up above the rest of the surface, being perhaps too hard to answer its purpose.

Mr. Wood, in the work before quoted, says, “The *males* are employed to collect the wood from the frames of windows, and from old posts and rails.” If by this he means that the males are employed *exclusively* in collecting materials, (and he does not mention that the neuters give them any assistance,) the statement cannot possibly be correct, and I much doubt whether they ever join the others at all in that part of the labours of the colony. They are certainly not produced early in the season, when the first neuters are hatched; and at all events their numbers are so small compared with the neuters, that they would be quite incapable of collecting sufficient wood for constructing a nest of ordinary dimensions. I believe that their chief occupation consists in cleaning and preparing the cells for successive broods, though they may perhaps occasionally assist the neuters in building and gathering materials; but the chief portion of the work is performed by the latter; and we accordingly find, that they are the first that die in the autumn, when there is no longer any necessity for their assistance. Kirby and Spence (vol. ii. p. 110.) likewise deny that the males assist in building or in feeding the young, but consider them as the “scavengers of the community, for they sweep the passages and streets, “ and carry away all the filth.”

The exterior covering of the nest of the *Vespa Britannica*, when completed, is composed of from ten to sixteen layers of the paper-like substance before mentioned, disposed one over the other, in such

a manner that each sheet barely touches the next, instead of being placed so as to form a solid mass. In this state, a nest is capable of resisting the heaviest rains. In both species the layers of cells in which the grubs are deposited are formed of the same materials as the outside, and are always placed with the opening of the cells downwards, differing in this respect from those of the bee, in which the cells are always in a horizontal position. Both species too commence their work from the top, and build downwards.

The nest of the tree wasp in its earliest state does not exceed an inch in diameter, and contains five or six cells only. It is formed of two semicircular layers of the paper, the upper one projecting a little over the other, so as to shoot off the rain. A hole is left at the bottom of it just large enough to admit the female wasp. As soon as the first workers quit their cells, they begin the task of enlarging the nest, and of adding fresh layers of cells in which the female immediately deposits more eggs. The nest however in all its stages has the appearance of being in a *finished state* externally, and it is probably this fact which has given rise to a great many mistakes in authors, who from finding nests varying in size from one to twelve inches in diameter, have been led to describe them as the productions of distinct species of wasps, whilst they were in reality the work of the *Vespa Britannica* alone. It sometimes of course happens, that when the nest is in its earliest state, the female wasp is accidentally destroyed when absent from it. In this case the neuters forsake their habitation, and by some curious instinct the young wasps which emerge from their

cells after the others have left it, immediately follow their exampleⁱ. Specimens of such deserted nests are occasionally found in the later months; and this has contributed to keep alive the error that they were the work of some rare species, to which the names of *Vespa Campanaria*, from the bell shape of the early nests, and *Vespa Holsatica* have been given.

Ray mentions "a species of *Vespa*, which attaches "its nest to the beam of a building, three inches in "diameter." This I have no doubt was the nest of the *Vespa Britannica*, and was probably found about May, when they usually attain that size.

Reaumur figures a nest^k which he says contained two layers of cells, and bore a considerable resemblance in size and shape to a half expanded Provence rose, and Kirby and Spence^l mention a nest, which they consider to be of the same species, except that it contained only one layer of cells, as occurring in a garden at East Dale. It is called *la Guêpe de Holstein*, (*Vespa Holsatica*,) by Latreille^m; but the descriptions given by these various authors agree precisely with that of the *Vespa Britannica*, to which species it must be referred. I am further confirmed in this opinion, from the fact that Reaumur's nest contained two layers of cells, and Kirby and Spence's only one. This shews, that however perfect the nest might appear externally, it was still in a state of progression, and that in both cases, had they been allowed to continue undisturbed, several more layers would have been added to each.

ⁱ Reaumur, vol. vi.

^k Reaumur, vol. vi. pl. 19. fig. 1, 2. The above figure is copied in Insect. Arch. p. 82.

^l Kirby and Spence, vol. i. p. 510.

^m Annales du Museum d'Hist. Nat. i. 289.

Mr. Knapp, in his very entertaining work, the *Journal of a Naturalist*, (p. 333, 2d edit.) mentions that he had seen the nest of another rare British species of wasp, which he calls *Vespa Campanaria*. It is fortunately figured in his work, and I venture to give the same explanation of it as of the others. Indeed, on comparing a small nest of the *Vespa Britannica* with his engraving, the similarity is such, that a doubt can hardly exist upon the subjectⁿ.

It seems that Mr. Knapp considers the *Vespa Campanaria* here spoken of, to be a distinct species from the *Vespa Holsatica*. Shaw, in the *Naturalist's Miscellany*^o, gives a figure of the nest of the “Campanular” “wasp,” to which he also applies the specific name *Vespa Holsatica* of Latreille. His engraving represents the nest in a somewhat more forward state than that of Mr. Knapp, and his figure of the wasp itself agrees in every respect with the *Vespa Britannica*. The account he gives of its habits is very vague, but he had evidently never seen the nest of a tree wasp in its mature state, as he goes on to say, “There is “an exotic species of wasp, a native of America, “which forms a nest on a plan *exactly similar* to “our present species, but differing in being much “larger, and having the concentric globes far more “numerous, viz. from ten to twelve or more. These “American wasps’ nests are commonly suspended “from, or rather affixed to, the small branches of “trees, as firs,” &c. Shaw was evidently not aware

ⁿ Several nests of the *Vespa Britannica*, in various stages, may be seen at the Ashmolean Museum, and will convey a better idea of the changes they undergo, and of their similarity to the engravings referred to, than any description.

^o Vol. xv. plate 603.

that these nests are common in Great Britain, and from his description I should infer that our species is identical with the American tree wasp, as may not improbably be the case, it being an inhabitant of so high a latitude. Mr. Stephens, in his catalogue of British insects, considers *Vespa Campanaria* to be identical with *Vespa Holsatica*, but distinct from *Vespa Britannica*, but even against so great an authority, I am inclined to think that further research will prove them to be all of one species.

The most curious opinion however that has been stated with regard to these early nests is that of Leach^p, who has given a very correct figure of the *Vespa Britannica*, as well as of the nest in its early state. He says, "In the spring, the female constructs "a nest: the eggs in a short time produce larvæ, "which are fed by the parent until they arrive at "maturity, when she closes the mouth of the cells. "Towards the latter end of summer they change "into the perfect state, and this brood consists en- "tirely of neuters, who with the parent, construct a "new nest of larger size, in the cells of which the "female deposits the remaining portion of her eggs, "whose offspring are fed and brought up by the "neuters. This second brood is made up of males, "females, and neuters, and the latter inmates, either "unite their efforts to enlarge the nest, or construct "a new habitation, and some of the females live over "the winter. Thus far I have ventured to assert "on my own observation."—"The autumnal nests "are found suspended from trees, especially from "pines, varying from the size of a pear to a foot in "diameter."

^p Leach's *Zoolog. Misc.* vol. i. pl. 50.

I have certainly never seen any thing tending to prove that wasps construct *two* nests in the year, and that they bring up part of their young in one nest, and then quit it, in order to undergo the labour of constructing a second, instead of enlarging the first; nor is there any analogy, in the history of any other insect, which would lead us to infer that such is likely to be the case. The fact, that the *same nest* is gradually enlarged from one to twelve inches in diameter, does not admit of a doubt, and a very slight degree of observation is sufficient to confirm it; and Leach is further in error, when he says that the first brood of neuters is not hatched till "late in the summer." It requires about thirty days^q from the time the egg is deposited, till its transformation into a perfect wasp is completed; and as the nests are commenced early in the spring, it follows that the first brood must emerge from their cells only a month later. It is also contrary to the opinion of all authors who have written upon the subject, to suppose that the mother of the brood covers the grubs herself with that silky covering under which their last transformation is completed. Reaumur frequently saw the larvæ in the act of spinning the envelope, and I can

^q The egg is usually hatched in eight days, and then assumes the form of a grub; it is then fed by the female for thirteen or fourteen days, when the grub covers the mouth of its cell with the silky substance before mentioned. It remains in this state about nine days more, and then eats its way through the covering, and joins the rest in the labours of the nest. As soon as any neuters are hatched, the care of feeding the larvæ devolves upon them, and from that time the female rarely if ever quits the nest. On emerging from the cell, the young wasp is somewhat lighter coloured than the rest, but is the same in all other respects.

confirm his account from the opportunities I have had of watching them. It appears therefore that Dr. Leach's statement is entitled to very little credit.

There is but one statement of Reaumur's, of any importance, which I have always found to be contradicted by my own experience; and upon this point I have the satisfaction of being able to bring forward the authority of Mr. Denison in my favour, who has paid great attention to the habits of wasps, and whose observations had also led him to a different conclusion from those of the French naturalist. It is with respect to the position that the larvæ of the *male* wasps occupy in the nest. Reaumur is speaking of the ground wasp, but his remarks apply equally to the other species. He says, "It is remarkable that the cells of the neuters are never mixed up with those of the males or of the females. One layer is composed exclusively of the cell of neuters, but the cells of the male and female grubs are often found in the same layer.—As the larvæ of these two sexes are of equal length, it is necessary for them to be provided with cells deep enough to suit them. But the cells of the male larvæ are narrower than those of the female ones, because the males never become equally large in diameter. I have often opened the cells, when the inmates were nearly ready to emerge, and I have always found that the cell contained either a male or a female, as I had previously supposed it would from its appearance." Kirby and Spence^r also quote this statement. I have never found in any single instance a male larva in the cells appropriated to females, and Mr. Denison has come to the same

^r Vol. i. p. 507.

conclusion after a careful examination of a great number of nests. I have repeatedly found male grubs mixed indiscriminately in the *upper* layers, which are always devoted to neuters, but have never seen an instance of the contrary. It is perfectly true, as Reaumur says, that the cells of neuter grubs are too short for the reception of those of males; but this defect is always remedied by the male grubs themselves, which lengthen the cells, so as to suit their own bodies, by spinning the silky covering of a convex form, which gives it the requisite size. The neuters, on the contrary, make the covering almost flat; and cells which have been used for rearing male grubs, are easily distinguished from the others, by their projecting beyond the general surface of the comb in a convex form. The lower layers of a nest, which are formed last, are occupied by females; and the difference in size of the cells, when compared with those of the upper layers, must be obvious to every one.

De Geer mentions, that in a small tree nest he found but one layer of cells, and that some of these cells were longer than others; probably, he says, for the reception of *females*; and he supposes the nest to be a perfect one of some new species of wasp. The probability however is, that, as in the other instances above mentioned, it was merely an early nest of the *Vespa Britannica*, of which one layer only was completed. The cells in a layer often differ a little in length from each other; and if any of them in this case were so much longer, as to make it probable they were not intended for neuters, which is somewhat doubtful, I should suppose that they were prepared for the reception of *male*, rather than *female* grubs, because the latter would require them to be

wider as well as longer; which De Geer does not say was the case.

The following notes were made on examining several nests of both species taken in the summer of 1833; and I have inserted them, to shew, in opposition to Reaumur, that male grubs are frequently found in the cells of the upper layers, which belong to the neuters.

No. 1. July 27th. A small nest of tree wasps.

1st layer contained none but neuters.

2d do. Neuters and males.

3d do. Females.

4th do. Only just begun, and not ready to receive the eggs.

Males and females are hardly ever hatched so early in the summer, and none but neuters were found in the nest.

No. 2. July 24. Tree wasps.

1st and 2d layers. Neuters with a few males amongst them.

3d and 4th do. Females not hatched.

No. 3. July 27. Tree wasps.

1st and 2d layers. Neuters with a few males.

3d and 4th do. Females.

5th do. Just commenced.

No. 4. August 6th. A large ground nest.

1st, 2d, 3d, 4th, and 5th layers. Neuters with a few males in each.

6th and 7th do. Females only.

No. 5. Aug. 7. Ground wasps; a large nest.

1st and 2d layers. Neuters only.

3d do. Neuters and males.

4th do. Neuters only.

5th do. Neuters and males.

6th and 7th do. Neuters only.

8th, 9th, and 10th do. Females only, the larvæ not far advanced.

No. 6. Aug. 8. Ground wasps.

1st layer. Neuters with one or two males.

2d do. Neuters only.

3d do. Neuters and males.

4th, 5th, 6th, 7th, do. Neuters only.

8th do. Females only.

Similar results were obtained from the examination of a great many other nests. I found no instance of a male grub in the female cells, which Reaumur states to be constantly the case, and am unable to offer any explanation of the disagreement between his observations, and those of Mr. Denison and myself. It is possible that Reaumur's descriptions were not founded on the inspection of a great number of nests, as he usually refers to one only which he had succeeded in transferring to his own house. Had he examined a greater quantity, and at different times in the summer, he could not have failed to observe the male grubs mixed indiscriminately amongst the neuters. At the same time I must own that further investigation may be expected to shew, that males are sometimes found in the female cells; as I cannot think that so acute an observer as Reaumur could have been mistaken, when he so positively asserts that fact on his own authority.

The beautiful arrangement by which the layers in the nest are attached to each other, so as to allow room for the wasps to walk between them, will be easily understood by examining any of the specimens in the Museum. In the ground nests, the supports or braces are round, like small columns, and dispersed at irregular distances. The upper end is spread along the edges of three cells, so as to divide the pressure, and yet allow room for the grubs to work their way out,

when they are come to maturity. In the tree nest a somewhat different arrangement is adopted. Instead of round pillar-like braces, thin slips of the paper of which the whole nest is composed, but made stiffer for this purpose, are continued along the edges of a number of cells, so as not to interfere with the inmates, and are finally fixed to the layer below. The number of these fastenings varies in every layer.

In examining the cells of some of the nests, a difficulty occurs of which I can offer no very satisfactory explanation. The cells of the uppermost layers are in some instances gnawed away, so as to be much too shallow for the reception of a grub. They all bear the marks of the teeth of the wasps, and are not eaten down with much regularity. The nests in which this peculiarity occurred, were taken about the middle of August, and I can only account for this appearance by supposing that at that time of year no more neuters were necessary for carrying on the works of the nest; and as any eggs deposited then, could not be matured before the middle of September, the cells were no longer wanted, and were gnawed away to give more room to the inmates. The female cells, being still occupied by the young in their various stages, were left entire. The larvæ that remain in the nest when the cold weather sets in, are always destroyed by the survivors, who find themselves unable any longer to procure food for them. The males are chiefly employed in this work, and may sometimes be seen dragging the grubs to the outside of the nest, where they are left to perish.

The females leave the nest in October, and seek

out for winter quarters, in which they remain in a torpid state till the warmth of spring again revives them. They conceal themselves in decayed stumps of trees, and under masses of moss and dead leaves, or under the tiles or slates of the roofs of houses. I dug out several during the last winter, and very frequently found humble bees in the same situations. The males and neuters die without exception, as soon as they have fulfilled the great end of their creation, and nearly all the authors assert that only a few females survive the rigour of the winter. This assertion is certainly difficult to be proved, and its truth has been inferred from the deficiency of wasps in some seasons, when they had been particularly abundant the year before. In the summer of 1832 I could not find a single tree wasp's nest, and only two or three of the ground species; but I conceive that the failure of wasps in such seasons depends more on the rigour of the spring, which often benumbs and destroys the females which had been tempted to leave their winter retreat too early, than on their being unable to resist the frosts of winter, when they are in a torpid state, and less likely to be affected by cold. I have observed great numbers of hive bees destroyed in a cold wet spring from the same cause, as well as other insects which had not the shelter of a hive to protect them, but which had nevertheless survived the frost of winter in a torpid state. Wasps are found to live through a Norwegian winter, and therefore no frost that occurs in this climate is likely to affect them^s.

^s Mr. Knight supposes that when a large number of females has appeared in the spring, and very few nests are found in the summer months, the failure proceeds from a deficiency of

Kirby and Spence^t say, that when the winter sets in, "the nest merely serves for the abode of a few benumbed females, and is entirely abandoned at the approach of spring." I have had frequent opportunities of opening nests during the winter, but have invariably found them empty, and have reason to believe that no females use them as a *hibernaculum*, but rather prefer seeking a retreat for themselves in the situations already mentioned.

Some writers have doubted the assertion that a sentinel is placed at the entrance of the nest, as soon as the wasps retire to rest in the evening; but I can state most positively that I have never seen a nest of either species, after about nine o'clock in the summer months, without observing the sentry at his post; and it is curious to see with what rapidity the alarm is conveyed to those within, when any attempt is made to meddle with him. I have sometimes thought that I could see a second sentinel at some distance behind the outer one; and judging from the usual distance from the entrance down to the nest, (often from two to three feet,) and the quickness of the communication with it, there may even be more. A lantern held near the sentinel does not seem to give him any alarm; but on touching the ground near him, he instantly disappears for a few seconds, and the inhabitants sally out immediately. I always capture the sentinel before proceeding to take the nest, and they are invariably neuters. A consider-

males in the preceding autumn. The explanation I have offered seems a more natural one.—*Vide Philosoph. Trans. for 1807, p. 243.*

^t Vol. i. p. 509.

able number of wasps pass the night upon the outside of the tree nest, in warm weather, but the sentinel is always to be seen at the entrance notwithstanding. It may be as well to mention, that in the ground nests there are two apertures, one for entrance, and the other for exit. The tree nest has usually only one, near the bottom; but in large colonies a second is often added; in which case there is a sentinel stationed at each.

There is a curious fact with regard to wasps, which, though already published, it may be worth while to mention, as I have had many opportunities of verifying it from experience; viz. that if the entrance to the nest be stopped up in the day time, the hundreds of wasps which are constantly returning to it make no attempt to sting the aggressor; but if one escape from the inside, it attacks him instantly, though not with the pertinacity of the common bee. I have often suffocated the wasps in a nest with a mixture of gunpowder and sulphur, in the day time, and proceeded to dig them out directly, whilst hundreds were flying about me in all directions, but I have hitherto escaped with impunity. If a common quart bottle half full of water, is placed in the cavity, and the ground levelled up again, so that the mouth of the bottle may as nearly as possible occupy the place of the former entrance, all the wasps that were absent at the time of the taking of the nest, will crowd into the bottle during the day; and I have usually found from 500 to 1500 wasps captured in it on the following morning. It is interesting to observe the young wasps eat their way through the covering of the cells when their transformation is complete. This they will continue

to do for several days after the nest is taken, particularly if kept in a warm place.

There are many curious circumstances connected with the habits of wasps, their mode of obtaining food, &c. which it is not the object of this paper to detail, because, as far as I can judge, they are correctly stated in all the works upon the subject.

I shall only refer to one other point in their natural history, and that is with regard to certain insect enemies to whose attacks they are exposed. There is a species of *Volucella*, the grub of which is figured in Kirby and Spence's work^u, and there described as inhabiting the nests of humble bees. It has also been found by Mr. Denison in those of wasps; but whether it feeds on the comb or the young wasps I do not know. Leach also speaks of wasps as being much infested by a small coleopterous insect called *Lebia Linearis*.

The active hostility which is carried on by the ichneumon tribe against the insect world in general has attracted the notice of all entomologists. But the social hymenoptera, the ant, the bee, and the wasp, have been said by the older naturalists to enjoy an exemption from the attacks of these formidable enemies: and the same statement has been repeated of late in the popular work of Messrs Kirby and Spence. "No ichneumon," say these authors, "has been yet found to deposit its eggs upon the larvae of the ant, the wasp, the humble bee, or the hive bee, in which last, had there been one appropriated to it, it could never have escaped the notice of the Reaumurs and the Hubers." As regards the wasp, however, it seems

^u Vol. i. p. 264; ii. p. 223, and Plate xix. fig. 11.

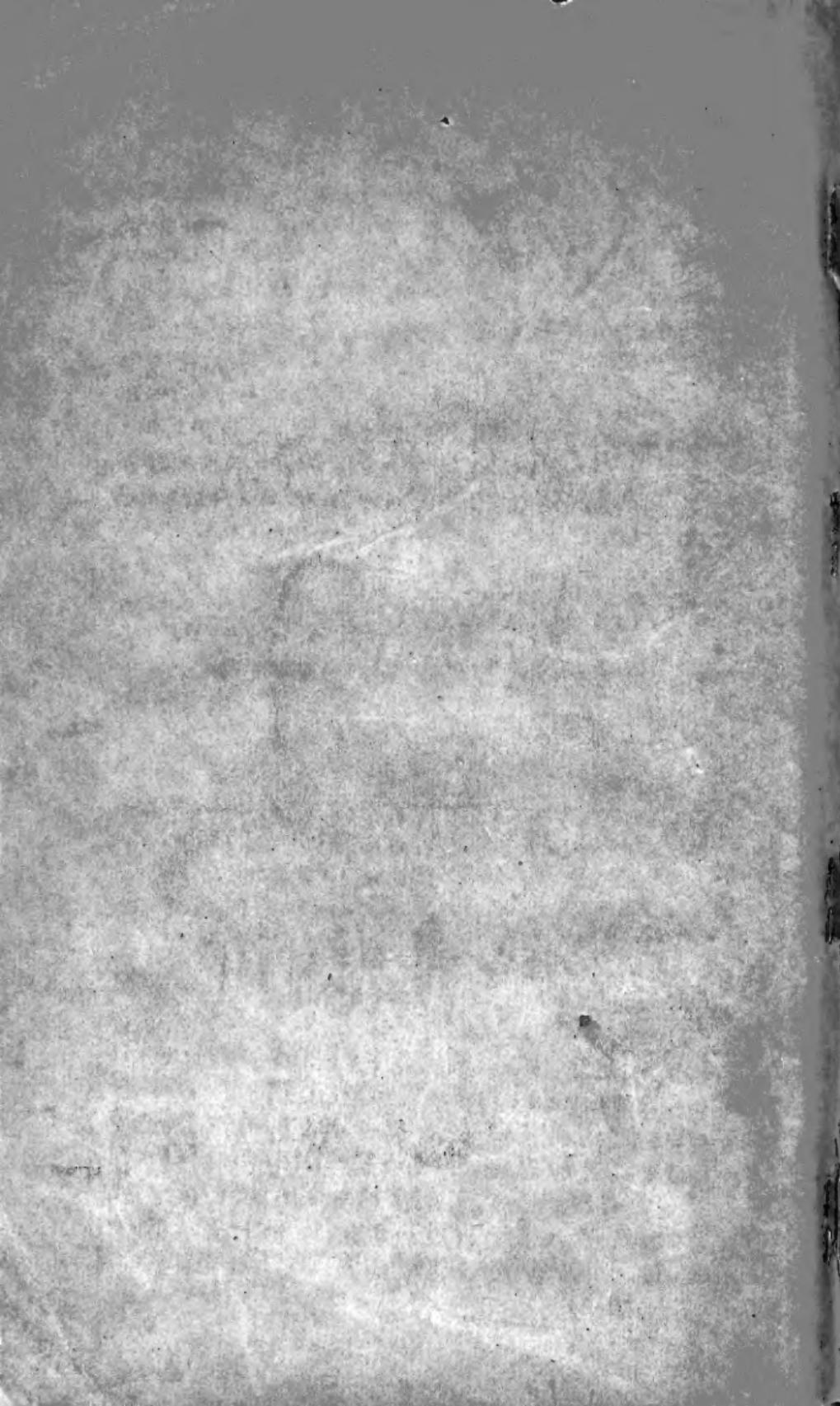
that this exemption does not exist; for though I have not myself been so fortunate as to find any species of ichneumon in their nests, one has been seen by Mr. Denison in several instances, and observed in all the stages of its growth. It is described by him as a fly as large, or nearly so, as the wasp itself: the head and forepart of the body black: the abdomen yellow, with a dark streak down the back: legs and under wings black: upper wings dusky. This fly deposits its egg upon the grub of the wasp at the moment it assumes the pupa: as soon as the egg is hatched, it devours the grub of the wasp entirely, and itself assumes the pupa and imago form in the cell of the wasp. As it is always found in cells closed up by the grub of the wasp in order to the assumption of the pupa state, it is probable that the parent fly may pierce the covering of the grub with its ovipositor, and lay its egg in that manner, the hole made in the covering being so small as to escape notice. These flies are most likely to be found where single cells are seen closed, after the inhabitants of the adjacent ones have quitted them; because the ichneumon has to go through three stages, while the wasp has only to pass the pupa state, supposing the grubs in the same layer to be nearly of an age at the time they were deposited. I am not aware that the existence of this ichneumon has ever been mentioned by any writer on entomology, nor was any other described till some time after this one had been observed by Mr. Denison; but a similar discovery has since been made by Mr. Wood of Manchester, who observes, " In examining " the combs of some wasps' nests, in one of them I " discovered many cells, about half the length of

" those of the wasps, and capped with wax^v. I put
" the comb into a glass jar, and the day following
" had the gratification of finding that they had eaten
" their way out of the cells." Mr. Wood has called this
species of ichneumon, *Anomalon Vesparum*; it dif-
fers considerably from Mr. Denison's, and is much
smaller. Mr. Curtis afterwards saw the cells con-
taining its young, and says, " It is worthy of remark,
" that the cells of the wasp containing the ano-
" malon, were closed like the others, and upon open-
" ing them, the exuviae of the wasp's grub filled up a
" space of about one third of the cell, from which we
" conclude that the eggs were deposited in the bodies
" of the larvæ, and lived upon them till they became
" nymphæ."

These late discoveries, as well as the many instances of disagreement and probable error, which I have pointed out, in the accounts both of the older and more recent writers upon the natural history of wasps, shew that there is still much room for further observations upon their habits; and I hope that some other members of the Society may be induced to carry on these investigations, so as to clear up any doubts which still exist.

^v I conclude that the covering of the cells of the ichneumon was not made of *wax*, but of that same silky substance in which the larvæ of other insects of that class envelope themselves.





JUL 2 - 1987

